Washington
Green Transportation Program
Moving forward with Washington's public fleets

EV Charging: Speeds, Ports & Specifications

When charging electric vehicles (EVs), electricity can be delivered as direct current (DC) or alternating current (AC). Batteries in battery electric vehicles (BEVs) store and deliver power as DC. DC fast charging (DCFC) equipment supplies DC power directly from the utility to the vehicle batteries, bypassing the on-board charger (OBC).

The power delivered through the electrical grid is AC. AC power, common for moderate-powered charging, must be converted to DC using the vehicle's OBC, also known as a rectifier.

Charging Speeds & Power Levels

Charging speed describes how fast energy is transferred from the electrical supply to the vehicle's battery. This speed varies within each charging level, depending on factors such as the ambient temperature, electrical supply, the car's OBC size, the battery capacity and state of charge (charge rates taper as the battery nears a full charge), and battery temperature.

- **Level 1 (L1)**: 110 volt (V) or 120 V such as a common indoor or outdoor wall outlet. Safe L1 charging requires a dedicated circuit, typically 20 amps (A), and is the slowest charging option.
- **Level 2 (L2)**: 208 V to 240 V. L2 charging stations use a 40 A circuit often found in residential, workplace, and public locations.
- **DC Fast Charge (DCFC)**: 480 V or higher. DCFC uses commercial three-phase power and can deliver power at various speeds. Modern EVs can recharge from 10% to 80% in 20 to 30 minutes with DCFC.
    - Depending on the vehicle's battery size and efficiency, some EVs will accept power levels from 250 to 350 kilowatt (kW). An EV with a 75 kilowatt hour (kWh) battery can replenish its state of charge to 80% in less than 20 minutes with a 350 kW charger; a 150 kW charger would take twice as long.
- **Extreme Fast Charging (EFX)**: Very high-power charging designed to fast-charge medium- and heavy-duty trucks, including semi-trucks. Such vehicles may demand power levels ranging from several hundred kW to more than 1 MW per vehicle. EFX charging lets operators quickly recharge large battery packs with capacities above 500 kWh.

Charging Taper

Charging to 80% instead of 100% is standard practice when fast charging because charging slows as a battery pack nears its storage capacity. The charging taper or overall charging speed might also be impacted by extreme ambient temperatures (below -40°F or over 110°F).

Each original equipment manufacturer (OEM) has a different charging taper as battery capacity nears full. Generally, larger batteries at a low state of charge can charge faster, which might be a factor when choosing which EV to buy. Actual charging time varies by vehicle type and specifications.

Charging Ports

Common charging ports currently used in North America are:

Nissan LEAF CHAdeMO quick charge port (left) and a J1772 Level 2 port (in use). Image: Flickr

- **CCS Combo**: Combined charging system, known as Combo. This charging plug supports AC and DC charging power levels up to 350 kW. In practice, the charging ranges from 50 kWh to 150 kWh.
- **CHAdeMO**: Charging plug used in DCFC systems. This is currently available in fewer models and is the only DC standard that offers vehicle-to-grid (V2G) connectivity.
- **J1772**: Plug/port style used for L2 (AC) charging. Part of the CCS configuration. (This is not the same as L2 for Tesla for destination charging.)
- **Tesla Superchargers**: Proprietary charging system and port (250 kWh to 400 kWh) that can only be used for Tesla EVs although several OEMs have announced that they are adopting the Tesla standard. The port also includes the AC L2 plug-in.
- **SAE**: Society of Automotive Engineers, the governing body that sets vehicle charging standards for the connectors AC-J1772, DC-CCS/Combo, and CHAdeMO.

Each of the main charging methods—L1, L2, and DCFC—provide different options and charging speeds. Common charging methods and types of ports used to connect charging equipment to vehicles are described on the Simplify EV Charging Connector Types and EV Charging Ports website.

Charging Specifications

EV charging equipment hardware must meet the following specifications:

- Certified to operate outdoors and in extreme weather conditions.
- Commercially available in Washington.
- Meet SAE J1772 standard for charging plug connector and operational requirements. For DCFC, hardware must include dual-protocol charging, compatible with both CHAdeMO and CCS1 Combo charging ports.
- Minimum lifespan of five years, a minimum three-year warranty, and a minimum five-year manufacturer's warranty.
- Certified through a nationally recognized testing laboratory (Underwriters Laboratories or an equivalent certification program) to demonstrate compliance with product safety standards.
- Certified with EPA ENERGY STAR.
- Compliant with the Open Charge Point Protocol 1.6.

EV charging equipment networks must meet the following requirements, as applicable:

- Maintain appropriate hardware and software that allows remote diagnostics and remote start of charging equipment, and collects and reports usage data.
- Ensure charging station data fields are available, free of charge, to third-party software developers via an interface that includes location, operator and network name, access type, port information, and pricing structure.

Networked EV charging equipment must accurately record and report:

- Number of charging events by month.
- Average duration of each charging event by month.
- kWs delivered by each charger at each site.
- Downtime at each charger at each site by month when monitored.

Charging equipment user interface should:

- Be legible in day and nighttime conditions.
- Be certified to operate outdoors and in extreme weather conditions.
- Include adequate cord length, protection, and storage.
- Include signage per Revised Code of Washington 46.08.185.

Specifications for Public Charging

EV charging equipment locations must have dedicated paved parking spaces available for charging services. These spaces must be adequately lit and safe from traffic circulation. They must also be maintained and repaired according to an operations and maintenance plan.

New rules for EV supply equipment from the Washington State Department of Agriculture (WSDA) will address:

- WAC 16-662-200 (payment methods and fee disclosures).
- WAC 16-662-215 (language requirements).
- WAC 16-662-220 (interoperability).

For public charging with payment required, point-of-sale payment methods such as pay per use and subscription methods must:

- Include the ability to accept credit, debit, and pre-paid cards (chip and tap readers) without incurring any additional fees or delays versus other payment or access control methods.
- Be offered without restriction based on network membership or subscription.
- Display clear, simple, and real-time pricing and fee information on device or payment screen.
- Be accessible to people with disabilities.
- Be compliant with appropriate Payment Card Industry Data Security Standards for the processing, transmission, and storage of cardholder data.
- Be operational and publicly accessible 24/7.
- Effectively communicate with EV drivers using or searching for a charging station if a station is not working, such as through a mobile app, text alerts, or similar technology.
- Include a signage plan that conforms to industry standards, including the WSDA.
- Provide 24/7 customer support service via a toll-free telephone number clearly posted near the charging equipment that is available to EV drivers accessing the charging equipment. This customer support must include a mechanism to report outages, malfunctions, or other issues with charging infrastructure.
- Ensure each port has an average annual uptime greater than 97%. A charging port is “up” when its hardware and software are online and available for driver use and it is dispensing electricity per the minimum power level requirements.

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